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Large-scale topology of dayside merging: Comparison of global MHD simulation results with measurements from the Double Star and Cluster spacecraft

J. Berchem (1), M. Dunlop (2), C. P. Escoubet (3), J. M. Bosqued (4), F. Pitout (5), Z. Pu (6), H. Reme (4), A. Balogh (7) and C. Carr (7)

(1) IGPP, University of California, Los Angeles, California 90095; (2) Rutherford Appleton Laboratory, Didcot, Oxon, OX11 0QX, United Kingdom; (3) ESA/ESTEC, Noordwijk, 2200 AG, The Netherlands; (4) CESR, Toulouse, 31000 France; (5) MPI für Extraterrestrische Physik, D-85748 Garching, Germany; (6) School of Earth and Space Sciences, Peking University, 100871 Beijing, China; (7) The Blackett Laboratory, Imperial College, London, SW7 2BZ, United Kingdom

Measurements from the DOUBLE STAR and CLUSTER spacecraft offer a unique opportunity to investigate the large-scale topology and dynamics of magnetic reconnection at the dayside magnetosphere. We present the results of several studies using three-dimensional global magnetohydrodynamic (MHD) simulations and observations from the DOUBLE STAR (TC1) and CLUSTER spacecraft. These studies consist of using interplanetary magnetic field (IMF) and plasma parameters measured by solar wind monitors upstream of the bow shock as input to the simulations and test the validity of their predictions by comparing large-scale topological features deduced from the simulations with local spacecraft measurements. We examined the topological properties of the magnetic field and plasma flows at the dayside magnetospheric boundary inferred from the simulations. Results indicate that the locations of the merging sites, though distorted, are mostly consistent with merging patterns predicted by the antiparallel merging model. The simulations also indicate that merging occurring at locations inconsistent with the model's predictions can often be explained by multiple merging processes. These studies emphasize the importance of the locations where discontinuities embedded in the solar wind impact the magnetosphere as well as the effects of the time evolution of the draping of the magnetosheath field in the global merging process, and hence the invaluable insight provided by global simulations.